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Kato et al.

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(54) **SEWING MACHINE AND UPPER FEED DEVICE**

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D05B 27/04 (2006.01)

(52) **U.S. Cl.**
CPC ***D05B 19/16*** (2013.01); ***D05B 27/04*** (2013.01)

(58) **Field of Classification Search**
CPC D05B 29/08; D05B 29/10; D05B 19/16; D05B 24/04
USPC 700/136–138
See application file for complete search history.

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(57) **ABSTRACT**

A sewing machine includes a first drive portion, a switching portion, a second drive portion, a control portion, and a memory. The first drive portion is configured to drive to feed, in a first direction, a work cloth. The switching portion is configured to switch a position of the first drive portion. The second drive portion is configured to drive to feed the work cloth. The memory is configured to store computer-readable instructions that instruct the sewing machine to execute steps of driving the first drive portion in the first position in a case where the second drive portion drives to feed the work cloth in the first direction and switching the position of the first drive portion to the second position in a case where the second drive portion drives to feed the work cloth in a second direction, based on the sewing data.

8 Claims, 12 Drawing Sheets

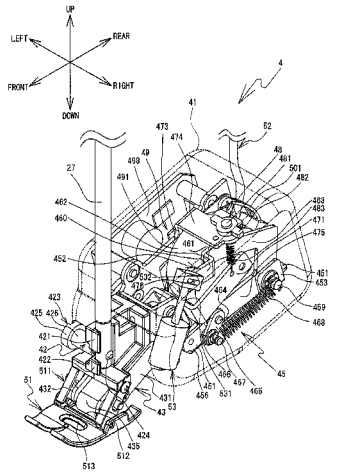

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FIG. 1

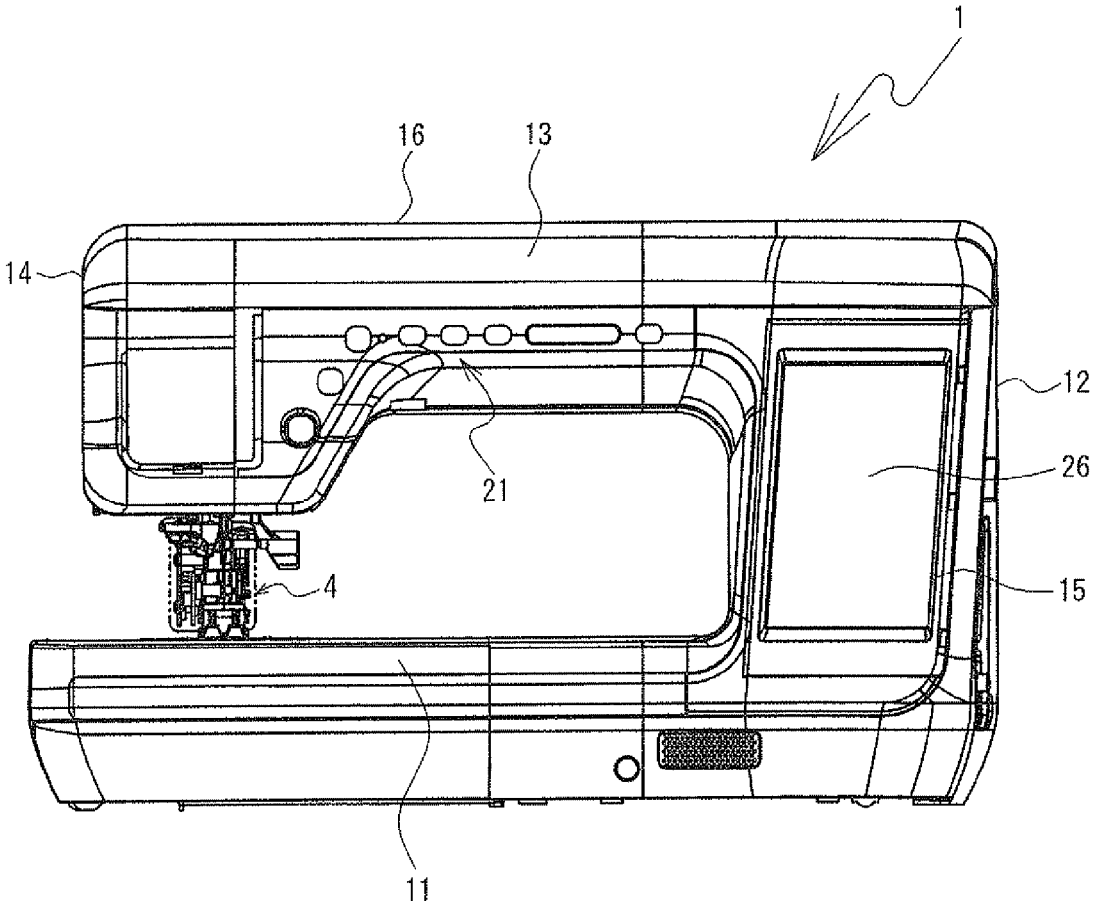


FIG. 2

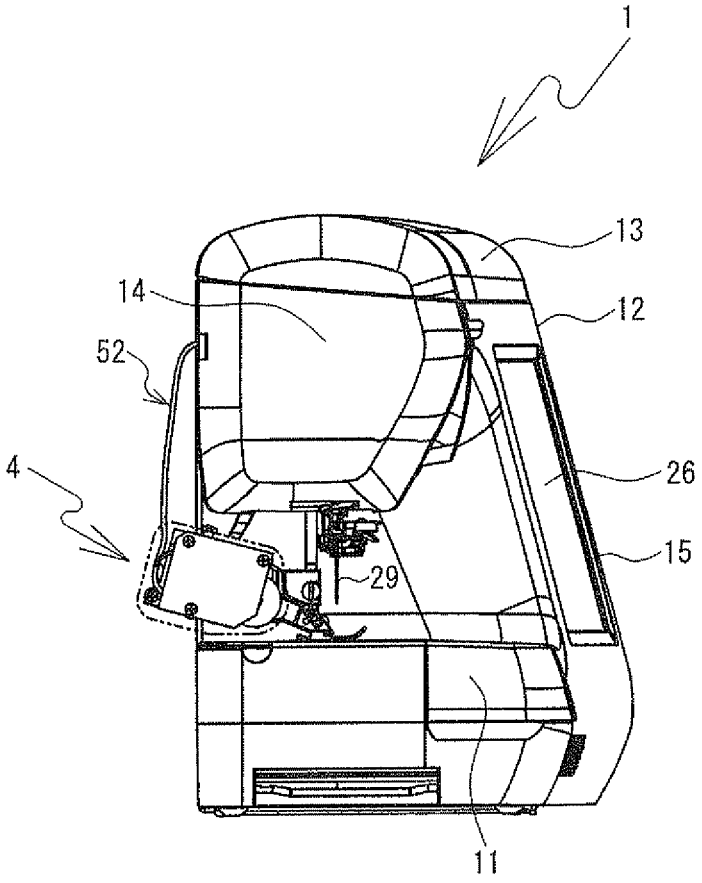


FIG. 3

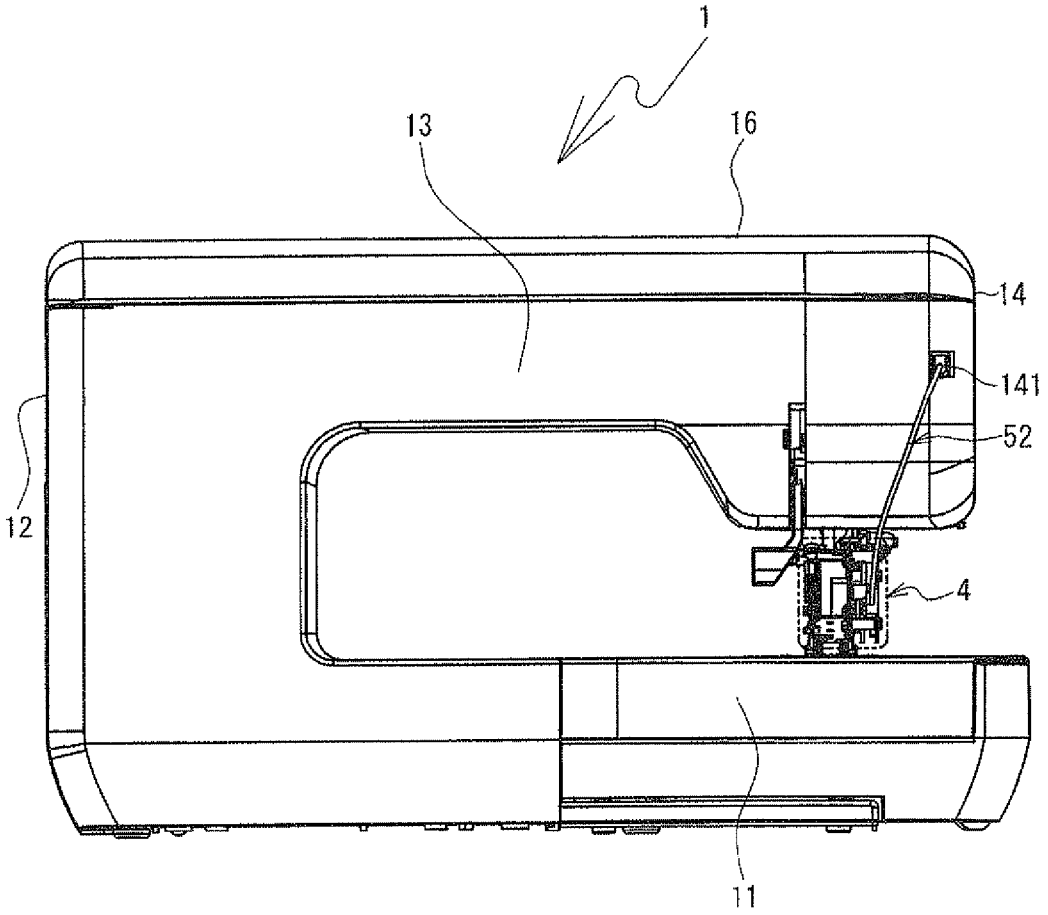


FIG. 4

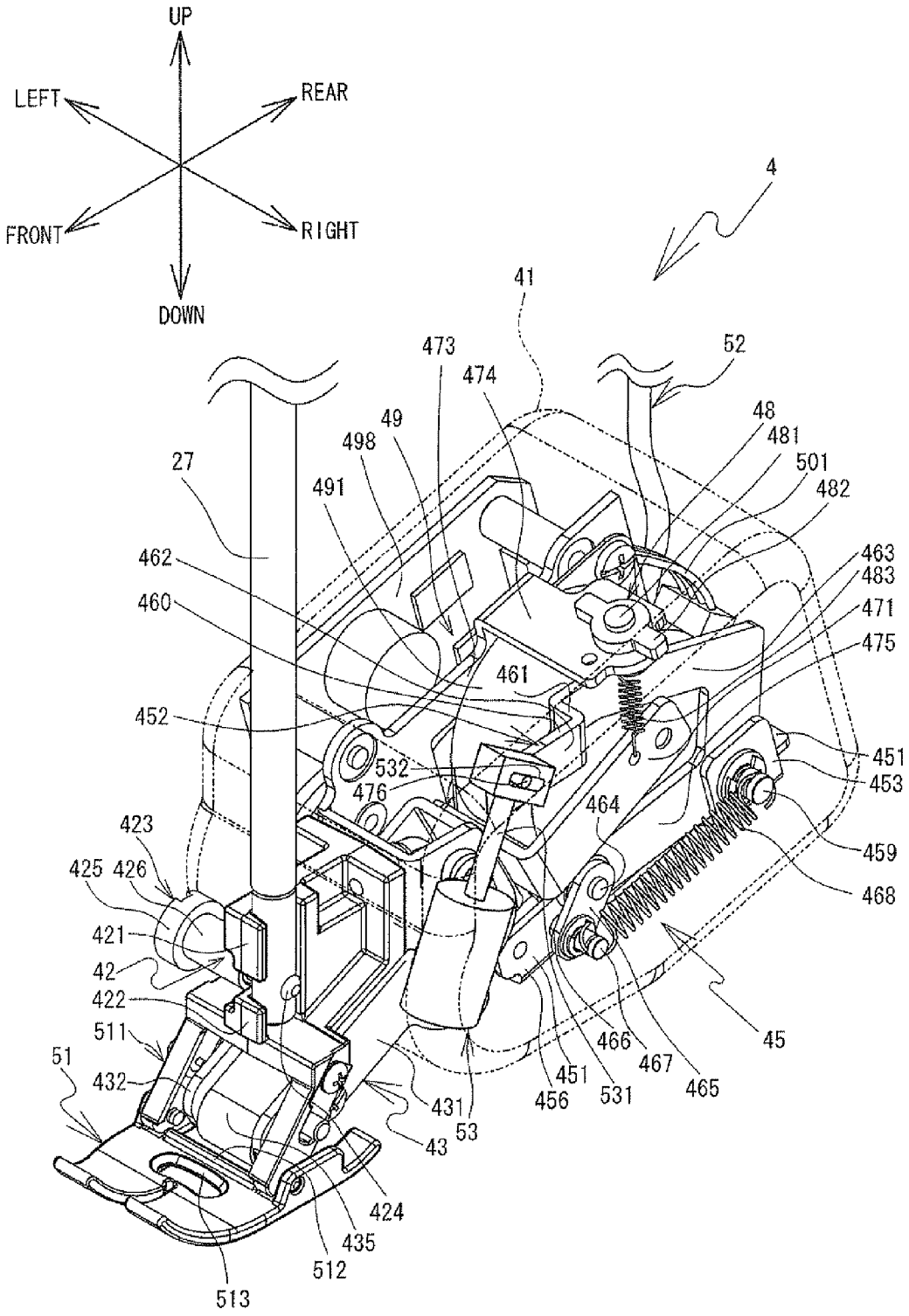

UP
LEFT
REAR
FRONT
RIGHT
DOWN
4
41
52
473
474
49
498
48
481
501
482
27
491
462
460
463
483
471
475
461
452
451
453
532
476
464
459
468
423
425
426
421
42
422
511
51
432
466
467
465
45
451
456
531
431
53
43
424
435
512
513

FIG. 5

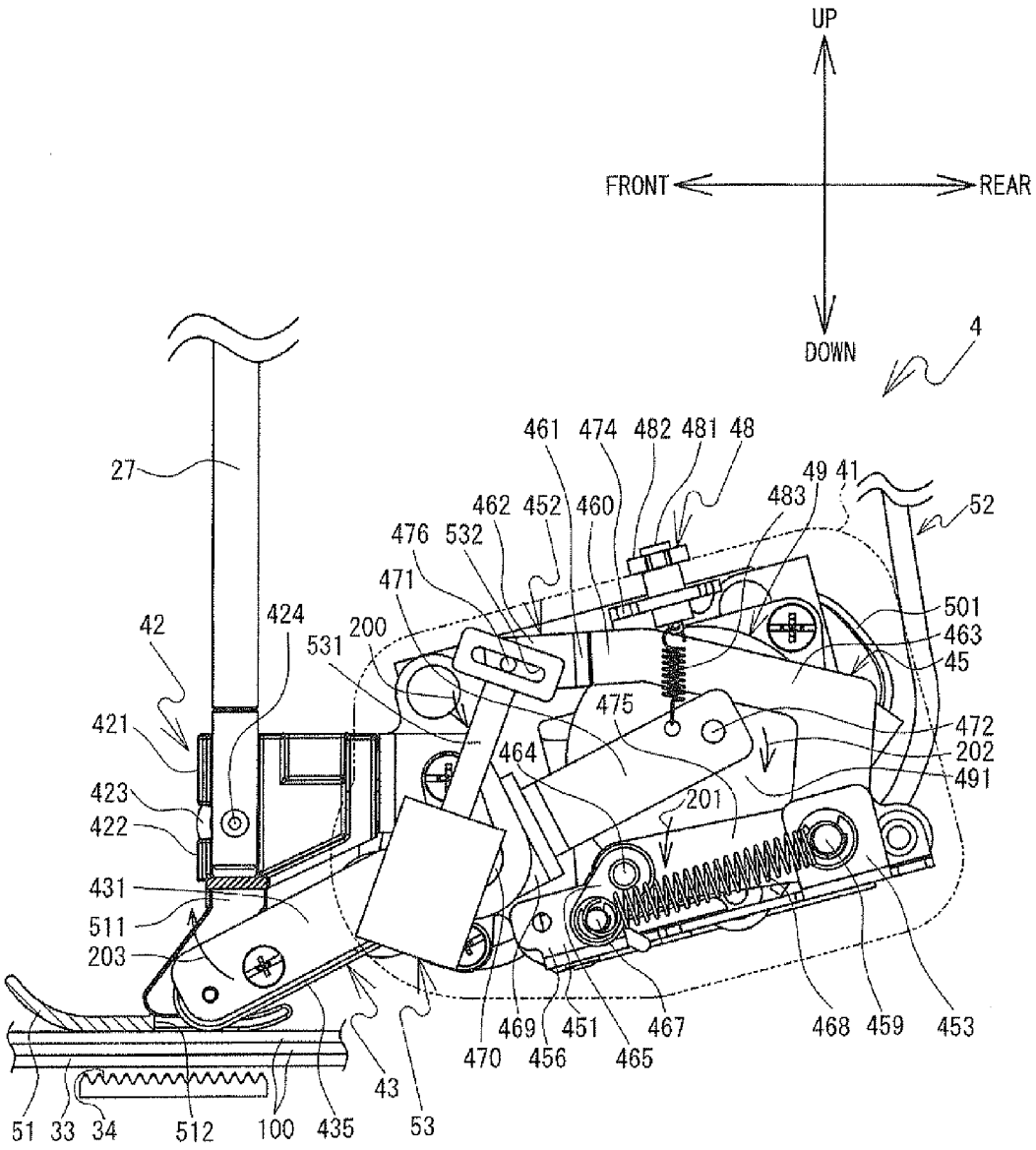

UP
FRONT
REAR
DOWN
4
27
461
474
482
481
48
49
41
483
52
462
452
460
476
532
471
501
463
45
42
424
200
531
475
472
421
464
202
491
423
201
422
431
511
203
469
451
467
468
459
453
470
456
465
43
53
51
33
34
512
100
435

FIG. 6

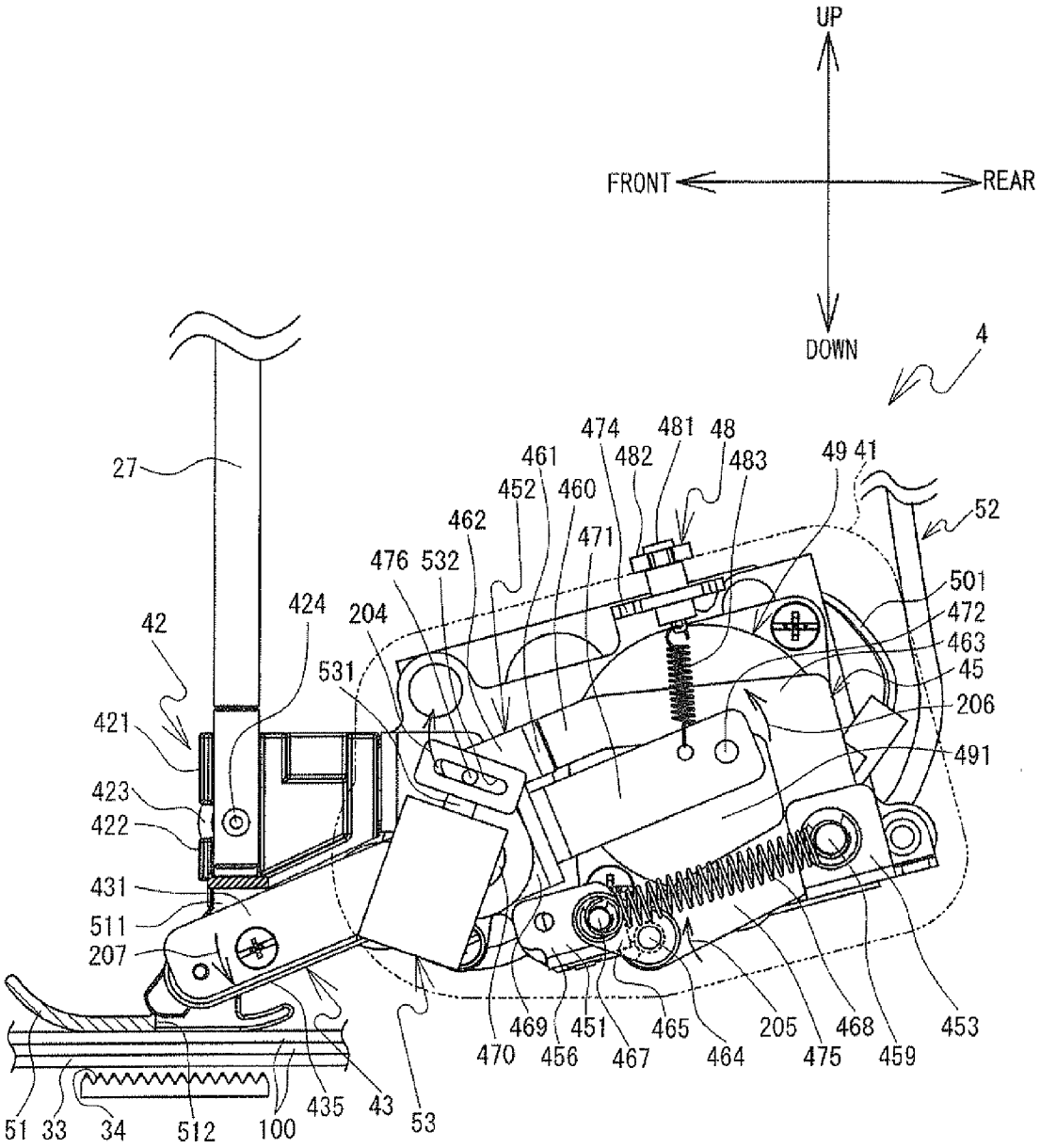

UP
FRONT
REAR
DOWN
4
27
42
421
423
422
431
511
207
424
204
531
476
532
462
452
461
460
471
474
482
481
48
483
49
41
52
501
472
463
45
206
491
469
470
456
451
467
465
464
205
475
468
459
453
51
33
34
512
100
435
43
53

FIG. 7

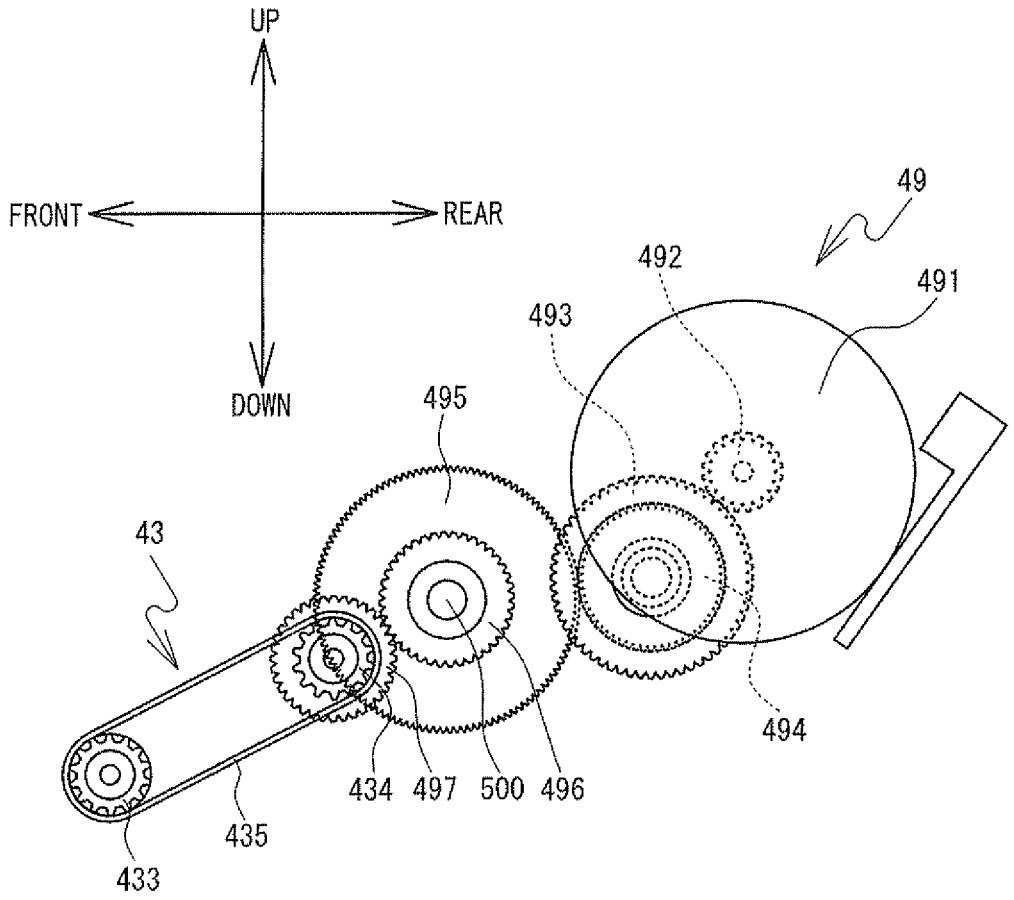

UP
FRONT
REAR
DOWN
49
492
491
493
495
43
494
434
497
500
496
435
433

FIG. 8

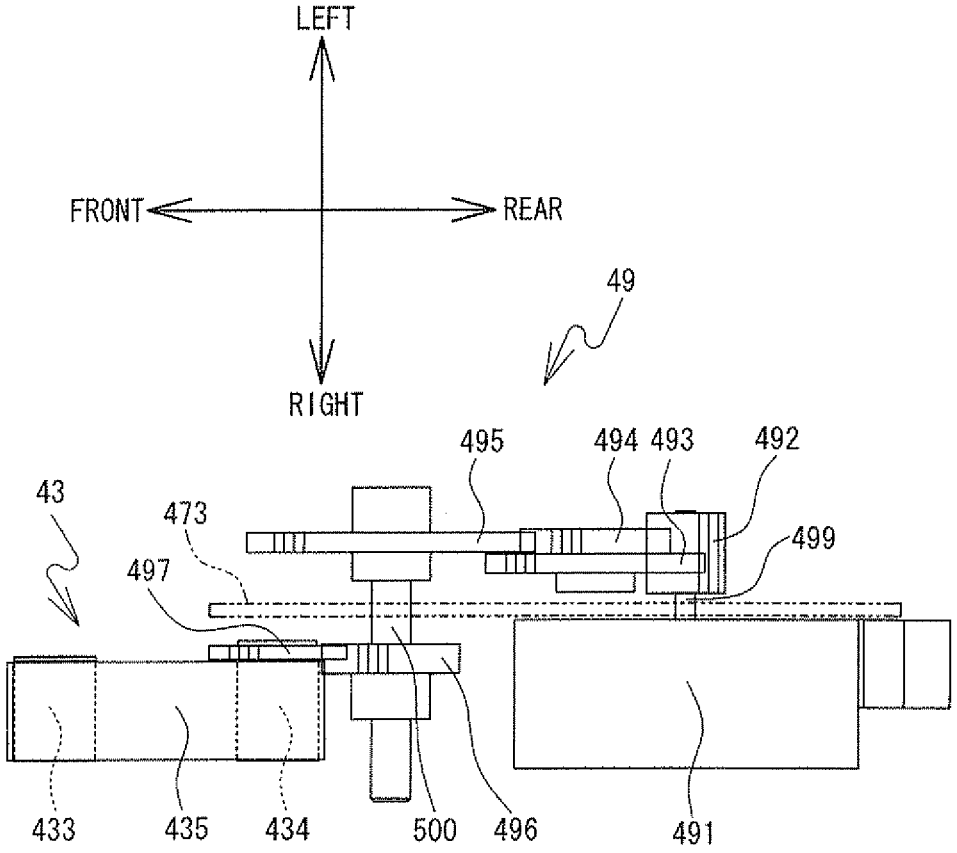

LEFT
FRONT
REAR
RIGHT
49
43
473
497
495
494
493
492
499
433
435
434
500
496
491

FIG. 9

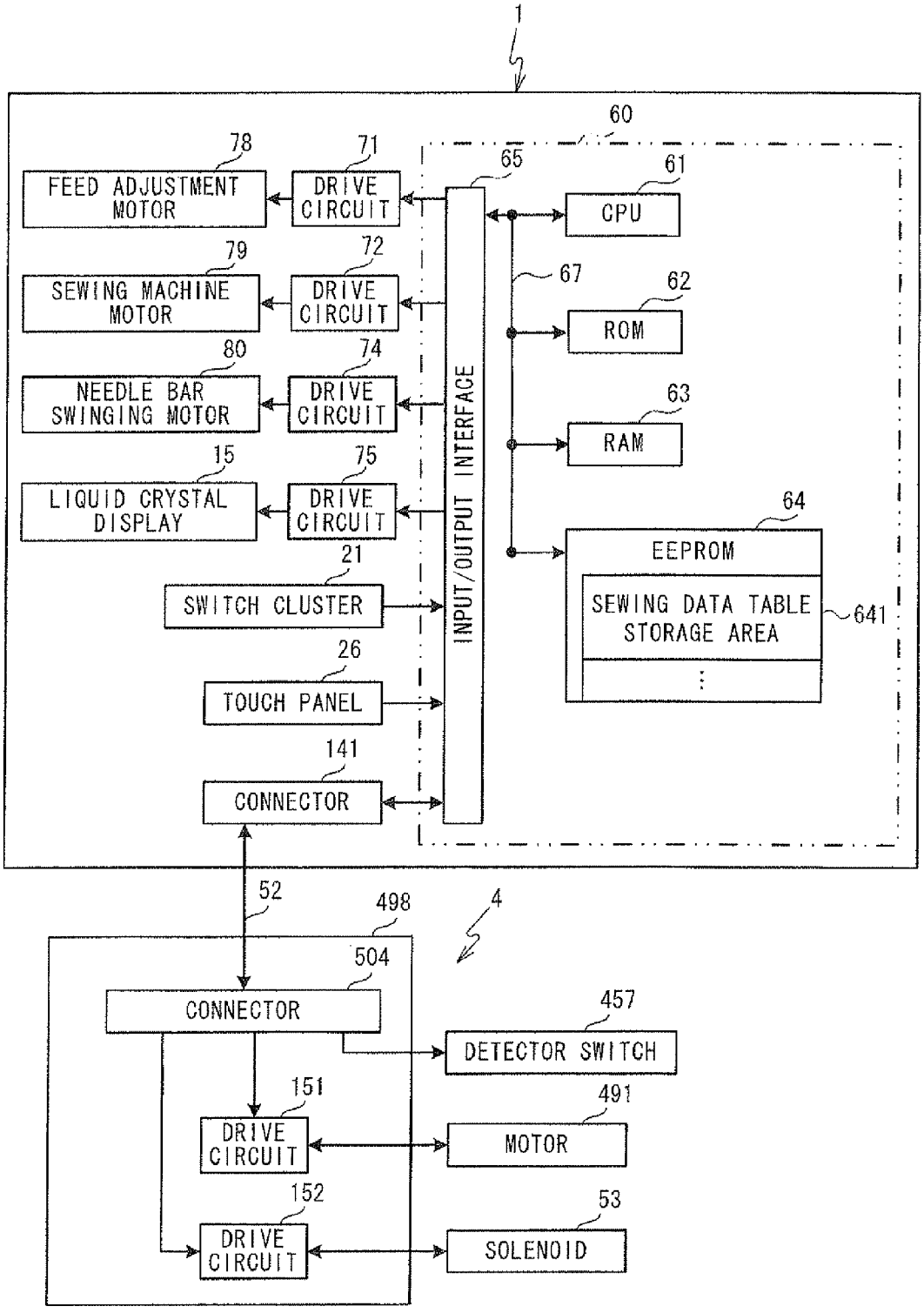

1
60
78
FEED ADJUSTMENT MOTOR
71
DRIVE CIRCUIT
65
61
CPU
79
SEWING MACHINE MOTOR
72
DRIVE CIRCUIT
67
62
ROM
80
NEEDLE BAR SWINGING MOTOR
74
DRIVE CIRCUIT
63
RAM
15
LIQUID CRYSTAL DISPLAY
75
DRIVE CIRCUIT
64
EEPROM
21
SWITCH CLUSTER
SEWING DATA TABLE STORAGE AREA
641
INPUT/OUTPUT INTERFACE
26
TOUCH PANEL
141
CONNECTOR
52
498
4
504
CONNECTOR
457
DETECTOR SWITCH
151
DRIVE CIRCUIT
491
MOTOR
152
DRIVE CIRCUIT
53
SOLENOID

FIG. 10

90

STITCH NUMBER N	SWING DATA	FRONT-REAR FEED DATA	TRANSVERSE FEED DATA
1	0mm	0mm	0mm
2	1.5mm	0mm	0.5mm
3	1.5mm	0mm	0.5mm
4	1.0mm	2mm	0mm
5	1.0mm	2mm	0mm
6	0.5mm	1mm	0mm
7	1.5mm	0mm	0.5mm
8	1.5mm	0mm	0.5mm
9	-1.5mm	0mm	-0.5mm
10	-1.5mm	0mm	-0.5mm
11	-1.0mm	2mm	0mm
12	-1.0mm	2mm	0mm
13	-0.5mm	1mm	0mm
14	-1.5mm	0mm	-0.5mm
15	-1.5mm	0mm	-0.5mm
⋮	⋮	⋮	⋮

FIG. 11

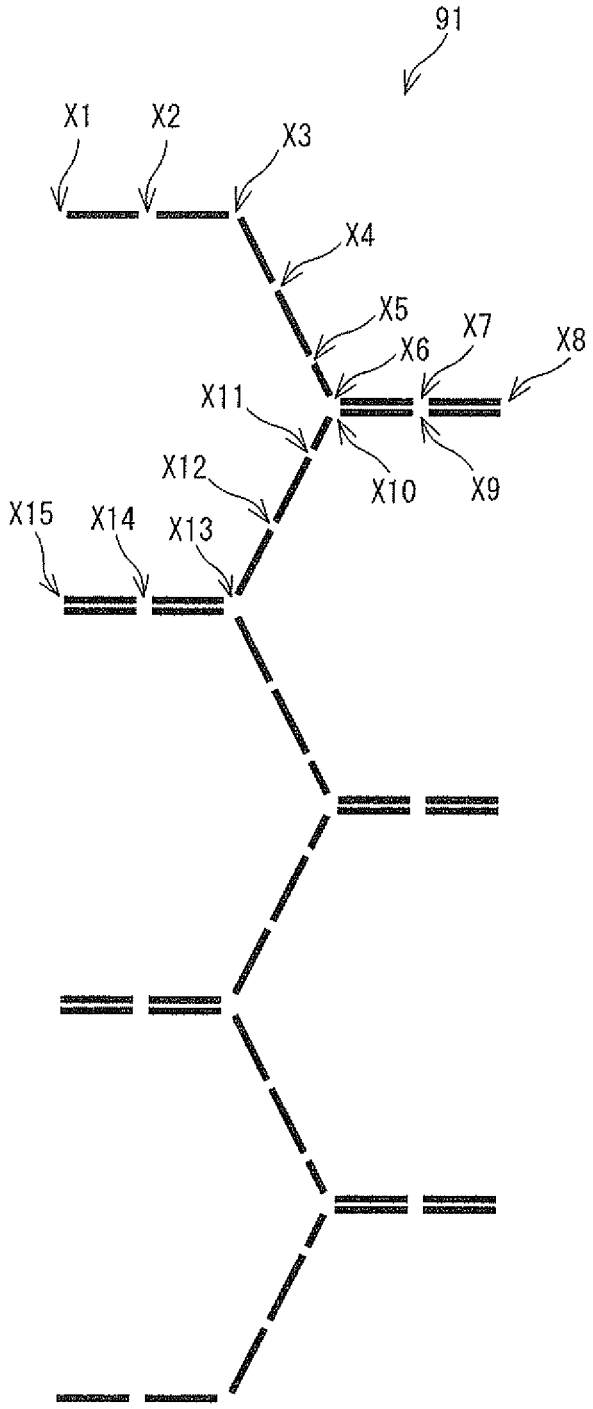
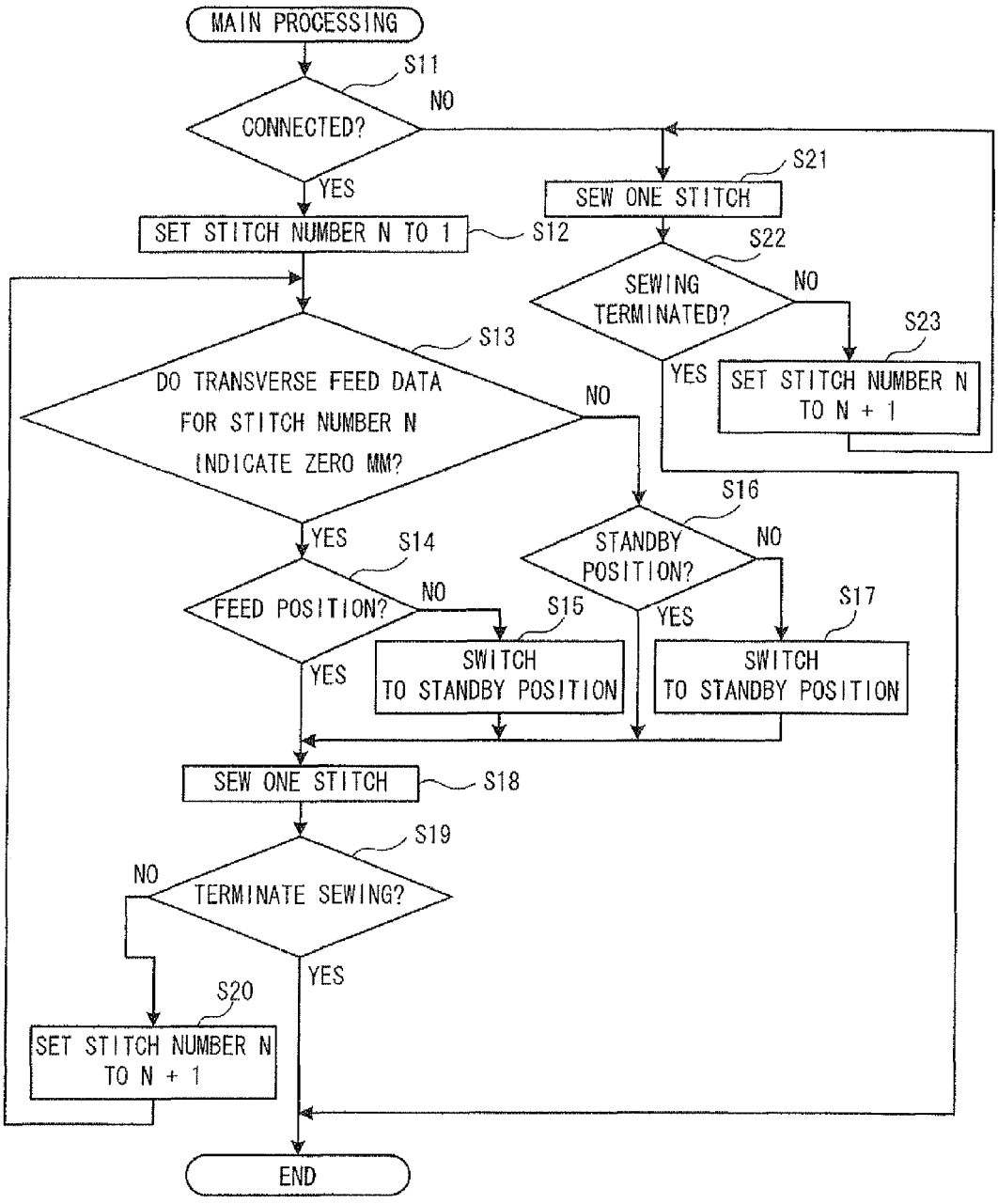


FIG. 12


MAIN PROCESSING
S11
CONNECTED?
NO
YES
SET STITCH NUMBER N TO 1
S12
S13
DO TRANSVERSE FEED DATA FOR STITCH NUMBER N INDICATE ZERO MM?
YES
NO
S14
FEED POSITION?
NO
YES
S15
SWITCH TO STANDBY POSITION
S16
STANDBY POSITION?
NO
YES
S17
SWITCH TO STANDBY POSITION
SEW ONE STITCH
S18
S19
TERMINATE SEWING?
NO
YES
S20
SET STITCH NUMBER N TO N + 1
S21
SEW ONE STITCH
S22
SEWING TERMINATED?
NO
YES
S23
SET STITCH NUMBER N TO N + 1
END

SEWING MACHINE AND UPPER FEED DEVICE

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority to Japanese Patent Application No. 2012-144988 filed Jun. 28, 2012, the content of which is hereby incorporated herein by reference.

BACKGROUND

The present disclosure relates to a sewing machine and an upper feed device.

A sewing machine is known that includes an upper feed device that is disposed higher than a bed of the sewing machine and that is capable of feeding a sewing object (a work cloth). For example, the sewing machine may be provided with a pull-feeding roller (which is equivalent to the upper feed device) above a support platform (which is equivalent to the bed). The pull-feed roller includes a roller element. The roller element is configured such that its position can be switched between a feed position and a released position. When a user switches the roller element to the feed position, the roller element may press the sewing object and, in synchronization with a feed dog, may feed the sewing object toward the rear of the sewing machine. When the user switches the roller element to the released position, the roller element may be separated from the sewing object. The user may therefore remove the sewing object from the support platform.

SUMMARY

A sewing machine is known that can sew a large pattern by using the feed dog to feed the sewing object not only in the front-rear direction, but also in the transverse (left-right) direction. However, in the upper feed device that is described above, the roller element can press and move the sewing object only toward the rear. Therefore, the roller element cannot feed the sewing object in the transverse direction. In a case where the upper feed device that is described above is being used while a large pattern is being sewn by using the feed dog to feed the sewing object in the front-rear direction and in the transverse direction, the roller element is pressing the sewing object, so the upper feed device cannot feed the sewing object properly in the transverse direction.

Embodiments of the broad principles derived herein provide a sewing machine and an upper feed device, the upper feed device being configured to be automatically separated from a sewing object when the sewing object is fed in a direction that is different from the direction in which the upper feed device feeds the sewing object.

Embodiments provide a sewing machine that includes a first drive portion, a switching portion, a second drive portion, a control portion, and a memory. The first drive portion is disposed above a bed of the sewing machine and is configured to drive to feed, in a first direction, a work cloth placed on the bed. The switching portion is configured to switch a position of the first drive portion between a first position and a second position. The first drive portion is configured to feed the work cloth at the first position. The first drive portion is configured to be separated from the work cloth at the second position. The second position is a position that is higher and farther away from the bed than the first position. The second drive portion is provided inside the bed and is configured to drive to feed the work cloth in the first direction and in a second direction that is different from the first direction. The memory is configured to store computer-readable instructions that instruct the sewing machine to execute steps of driving the first drive portion in the first position, in a case where the second drive portion drives to feed the work cloth in the first direction, based on sewing data, and switching the position of the first drive portion from the first position to the second position by operating the switching portion, in a case where the second drive portion drives to feed the work cloth in the second direction, based on the sewing data.

Embodiments also provide an upper feed device that includes a first drive portion and a switching portion. The first drive portion is disposed above a bed of a sewing machine and is configured to drive to feed, in a first direction, a work cloth placed on the bed. The switching portion is configured to switch a position of the first drive portion between a first position and a second position. The first drive portion is configured to feed the work cloth at the first position. The first drive portion is configured to be separated from the work cloth at the second position. The second position is a position that is different from the first position. In response to instructions that is output by a control portion of the sewing machine based on sewing data, the first drive portion drives in the first position in a case where a second drive portion drives to feed the work cloth in the first direction, and the switching portion switches the position of the first drive portion from the first position to the second position in a case where the second drive portion drives to feed the work cloth in a second direction that is different from the first direction. The second drive portion is provided inside the bed.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments will be described below in detail with reference to the accompanying drawings in which:

FIG. **1** is a front view of a sewing machine;

FIG. **2** is a left side view of the sewing machine;

FIG. **3** is a rear view of the sewing machine;

FIG. **4** is an oblique view of an upper feed device when a feed mechanism is in a feed position;

FIG. **5** is a right side view of the upper feed device when the feed mechanism is in the feed position, with an area including a presser foot shown in cross section;

FIG. **6** is a right side view of the upper feed device when the feed mechanism that is shown in FIG. **5** has moved to a standby position;

FIG. **7** is a right side view of a drive mechanism that is configured to drive a belt;

FIG. **8** is a plan view of the drive mechanism that is configured to drive the belt;

FIG. **9** is a block diagram that shows an electrical configuration of the sewing machine and the upper feed device;

FIG. **10** is a data configuration diagram of a sewing data table;

FIG. **11** is a sewing pattern that is to be sewn based on the sewing data table; and

FIG. **12** is a flowchart of main processing;

DETAILED DESCRIPTION

Hereinafter, an embodiment will be explained with reference to the drawings. A sewing machine **1** according to the present embodiment can form a stitch on a work cloth by moving the work cloth in relation to a needle that is moved up and down. The sewing machine **1** according to the present

embodiment is an example of a sewing machine to which an upper feed device **4**, which will be described below, can be mounted.

A physical structure of the sewing machine **1** will be explained with reference to FIGS. **1** to **3**. In the following explanation, the near side, the far side, the upper side, the lower side, the left side, and the right side of FIG. **1** are respectively defined as the front side, the rear side, the upper side, the lower side, the left side, and the right side of the sewing machine **1**. In other words, a direction in which a pillar **12**, which will be explained below, extends is the up-down direction of the sewing machine **1**. A longitudinal direction of a bed **11** and an arm **13** is the left-right direction of the sewing machine **1**. A surface on which a switch cluster **21** is arranged is the front surface of the sewing machine **1**.

As shown in FIG. **1**, the sewing machine **1** includes the bed **11**, the pillar **12**, the arm **13**, and a head **14**. The bed **11** extends in the left-right direction. The pillar **12** extends upward from the right end of the bed **11**. The arm **13** extends toward the left from the top end of the pillar **12**. The head **14** is provided on the left end of the arm **13**. The bed **11** is provided with a needle plate **33** (refer to FIG. **5**), a feed dog **34** (refer to FIG. **5**), a cloth feed mechanism (not shown in the drawings), a feed adjustment motor **78** (refer to FIG. **9**), and a shuttle mechanism (not shown in the drawings). The needle plate **33** is disposed on the top face of the bed **11**. The feed dog **34** is provided inside the bed **11**, more specifically, underneath the needle plate **33**. The feed dog **34** may feed a work cloth **100** (refer to FIG. **5**) that is placed on the top face of the bed **11** and the needle plate **33** by a specified feed amount. The cloth feed mechanism may drive the feed dog **34**. The feed adjustment pulse motor **78** may adjust the feed amount.

The cloth feed mechanism may drive the feed dog **34** to move in the front-rear direction and in the left-right direction (the transverse direction). The feed dog **34** may feed the work cloth **100** in the front-rear direction and in the left-right direction (the transverse direction). In contrast, a feed mechanism **43** (refer to FIG. **4**) of the upper feed device **4**, which will be described below, may feed the work cloth **100** only in the front-rear direction. The head **14** is provided with a needle bar mechanism (not shown in the drawings), a needle bar swinging mechanism (not shown in the drawings), a needle bar swinging motor **80** (refer to FIG. **9**), and a thread take-up mechanism (not shown in the drawings). The needle bar mechanism may drive a needle bar (not shown in the drawings) in the up-down direction. A sewing needle **29** (refer to FIG. **2**) may be attached to the needle bar. The needle bar swinging mechanism may swing the needle bar to the left and to the right. The needle bar swinging motor **80** may drive the needle bar swinging mechanism.

A liquid crystal display **15** is provided on the front face of the pillar **12**. The liquid crystal display **15** has a vertical rectangular shape. For example, keys that are used to execute various functions necessary to the sewing operation, various messages, and various patterns etc. may be displayed on the liquid crystal display **15**. A transparent touch panel **26** is provided in the upper surface (front surface) of the liquid crystal display **15**. A user may perform an operation of pressing the touch panel **26**, using a finger or a dedicated touch pen, in a position corresponding to one of the various keys or the like displayed on the liquid crystal display **15**. This operation is hereinafter referred to as a "panel operation". By performing the panel operation, the user may perform selection of a sewing pattern (a sewing data table), various settings, and the like.

The structure of the arm **13** will be explained. A cover **16** is attached to the upper portion of the arm **13** along the longitudinal direction of the arm **13**. The cover **16** is supported such that the cover **16** can be opened and closed by being rotated about an axis that extends in the left-right direction at the upper rear edge of the arm **13**. A thread container portion (not shown in the drawings) is provided close to the middle of the top of the arm **13** under the cover **16**. The thread container portion is a recessed portion for containing a thread spool (not shown in the drawings). A spool pin is provided in the thread container portion. A thread spool may be mounted to the spool pin. The head **14** is provided with a thread guide that includes a tensioner, a thread take-up spring, a thread take-up lever, and the like, which are not shown in the drawings. An upper thread (not shown in the drawings) may be supplied from the thread spool via the thread guide to the sewing needle **29** that is attached to the needle bar.

A sewing machine motor **79** (refer to FIG. **15**) is provided inside the pillar **12**. The sewing machine motor **79** may rotate a drive shaft (not shown in the drawings). The drive shaft extends in the direction in which the arm **13** extends. The needle bar mechanism and the thread take-up mechanism may be driven by the rotating of the drive shaft. The switch cluster **21** is provided on the lower part of the front face of the arm **13**. The switch cluster **21** includes a sewing start/stop switch, a reverse stitch switch, a needle up/down switch, and the like.

A presser bar **27** (refer to FIG. **5**) is located at the rear of the needle bar. The upper feed device **4** may be mounted to the lower end of the presser bar **27**. The upper feed device **4** may be positioned higher than the bed **11**. The upper feed device **4** may feed the work cloth **100** by operating in coordination with the feed dog **34**.

The upper feed device **4** will be explained with reference to FIGS. **4** to **7**. As shown in FIGS. **4** and **5**, the upper feed device **4** includes a housing **41**, a mounting portion **42**, the feed mechanism **43**, a drive mechanism **49**, a switching mechanism **45**, a pressure adjustment mechanism **48**, a connecting portion **52**, and a presser foot **51**. The mounting portion **42** is a portion by which the upper feed device **4** can be mounted on the presser bar **27** of the sewing machine **1**. The feed mechanism **43** may be disposed above the bed **11**. The feed mechanism **43** may feed the work cloth **100** that is placed on the bed **11** in the front-rear direction. The drive mechanism **49** may drive the feed mechanism **43**. The switching mechanism **45** may switch the position of the feed mechanism **43** between a feed position (refer to FIG. **5**) and a standby position (refer to FIG. **6**). The feed position is a position in which the feed mechanism **43** can press and feed the work cloth **100**. The standby position is a position in which the feed mechanism **43** is separated from the work cloth **100** and does not feed the work cloth **100**. The connecting portion **52** may electrically connect a motor **491** and a solenoid **53** to a control portion **60** (refer to FIG. **9**) of the sewing machine **1**. The motor **491** is provided in the drive mechanism **49**. The solenoid **53** is provided in the switching mechanism **45**. The pressure adjustment mechanism **48** may adjust the pressure of a belt **435** on the work cloth **100**. The belt **435** is provided in the feed mechanism **43**.

The switching mechanism **45** is provided inside the housing **41**. The switching mechanism **45** includes a base portion **451**, a lever plate **452**, a spring **468**, a rotating member **469**, a rotating plate **471**, and the solenoid **53**. The base portion **451** is a plate-shaped member that extends in the front-rear direction at the lower portion inside the housing **41**. Bent portions are provided on the side faces of the front and rear ends of the base portion **451**. The bent portions are portions that are each bent upward from the base portion **451**. FIGS. **4** to **6** show a bent portion **453** and a bent portion **456** among the bent

portions. The bent portion **453** is provided in the right rear part of the base portion **451**. The bent portion **456** is provided in the right front part of the base portion **451**.

A shaft member **459** is inserted through the bent portion **453**. The plate-shaped lever plate **452** is provided on the left end of the shaft member **459**. The lever plate **452** can be rotated with the shaft member **459** as the center of rotation. The lever plate **452** includes a lever portion **460** and an extension portion **475**. The lever portion **460** extends upward from the location where the shaft member **459** is inserted, and then extends toward the front. At a bent portion **461** that is in a central portion of the lever portion **460** in the front-rear direction, the lever portion **460** bends toward the right and then extends toward the front again. A cylindrical portion **476** is provided on the tip of the lever portion **460**. The cylindrical portion **476** projects toward the right from the lever portion **460**. The solenoid **53** is disposed below and in front of the tip of the lever portion **460**. The solenoid **53** includes a drive shaft **531**. The drive shaft **531** projects upward and rearward. The tip of the drive shaft **531** is formed into a rectangular shape in a right side view and is provided with a hole **532**, which passes through the tip in the left-right direction. The hole **532** extends obliquely from the upper front to the lower rear. The cylindrical portion **476** is fitted into the hole **532** such that the cylindrical portion **476** can slide within the hole **532**. The solenoid **53** may move the drive shaft **531** to the upper rear and to the lower front. The drive shaft **531** may thus move the lever portion **460** up and down by acting on the cylindrical portion **476**. In the explanation that follows, the part of the lever portion **460** that is toward the front from the position of the bent portion **461** is referred to as a lever front end portion **462**, and the part of the lever portion **460** that is toward the rear from the position of the bent portion **461** is referred to as a lever rear end portion **463**.

The extension portion **475** extends toward the front from the location where the shaft member **459** is inserted. A shaft member **464** is inserted through the front end portion of the extension portion **475** in the left-right direction. The shaft member **464** may be moved up and down in conjunction with the rotation of the lever plate **452**. A detector switch **457** (refer to FIG. **9**) is disposed on the base portion **451**. The left end portion of the shaft member **464** turns the detector switch **457** on and off by moving up and down.

As shown in FIG. **5**, a rear end portion of a linking member **465** is coupled to the right end portion of the shaft member **464**. A hole **466** is provided in the bent portion **456** in the right front portion of the base portion **451** (refer to FIG. **4**). The hole **466** is slightly elongated in the front-rear direction. A shaft member **467** is inserted through the hole **466**. The shaft member **467** can be slid in the front-rear direction within the hole **466**. The shaft member **467** is coupled to the front end portion of the linking member **465**. The spring **468** is provided such that the shaft member **467** is coupled with the shaft member **459**. The spring **468** is provided in an extended state. Therefore, the spring **468** constantly generates a force in the direction of contraction. The shaft member **467** is therefore pulled toward the rear by the spring **468**. Accordingly, the shaft member **467** is in contact with the rear end portion of the hole **466** (refer to FIG. **4**).

As shown in FIG. **5**, the rotating member **469** is provided above the front end of the base portion **451**. The rotating member **469** can be rotated with a central shaft **470** of the rotating member **469** as the center of rotation. The rotating plate **471** is coupled to the rear portion of the rotating member **469**. The rotating plate **471** extends obliquely upward and rearward. The rear portion of the rotating plate **471** is positioned to the right of the lever rear portion **463** (refer to FIG. **4**). A shaft member **472** (not shown in FIG. **4**) extends toward the left from the rear end portion of the rotating plate **471**. The shaft member **472** is positioned below the lever rear portion **463**. The front end of the rotating member **469** is coupled to the feed mechanism **43**.

The feed mechanism **43** will be explained. The feed mechanism **43** extends obliquely downward and forward. The feed mechanism **43** includes plate portions **431**, **432** (refer to FIG. **4**), pulleys **433**, **434** (refer to FIG. **7**), and the belt **435**. As shown in FIG. **4**, the plate portions **431** and **432** are positioned opposite one another. The plate portions **431** and **432** extend obliquely downward toward the front from the front end of the rotating member **469** (refer to FIG. **5**). The front end portions of the plate portions **431** and **432** support the pulley **433** such that the pulley **433** can be rotated. The rear end portions of the plate portions **431** and **432** support the pulley **434** such that the pulley **434** can be rotated. The belt **435** is provided around the pulley **433** and the pulley **434** (refer to FIG. **7**). The front end portion of the belt **435** is positioned at a belt positioning portion **512** (described below) of the presser foot **51**. When the feed mechanism **43** is in the feed position (refer to FIG. **5**), the part of the belt **435** that is below the pulley **433** may press the work cloth **100** and may feed the work cloth **100** in the front-rear direction. The way in which the position of the feed mechanism **43** is switched by the switching mechanism **45** will be described below.

A structure for adjusting the pressure when the feed mechanism **43** presses against the work cloth **100** will be explained. A lower edge portion of a plate portion **473** (refer to FIG. **4**) is affixed by screws (not shown in the drawings) to the bent portions (not shown in the drawings) on the left side of the base portion **451**. As shown in FIG. **4**, the plate portion **473** extends upward. An extension portion **474**, which extends toward the right, is provided in a central portion of the upper edge of the plate portion **473** in the front-rear direction. The extension portion **474** is positioned above the motor **491** (described below). The pressure adjustment mechanism **48** is provided on the right end portion of the extension portion **474**.

The pressure adjustment mechanism **48** includes a male threaded portion **481**, a female threaded portion **482**, and a spring **483**. The male threaded portion **481** penetrates in the up-down direction through the top face of the housing **41** and through the extension portion **474**. The female threaded portion **482** is located on the top side of the top face of the housing **41** above the extension portion **474** (refer to FIG. **5**). The upper end portion of the male threaded portion **481** is inserted through the female threaded portion **482**. The upper end portion of the spring **483** is fixed to the lower end portion of the male threaded portion **481**. The spring **483** extends downward. The lower end portion of the spring **483** is fixed to the rear end portion of the rotating plate **471**. The spring **483** pulls the rear end portion of the rotating plate **471** upward.

The male threaded portion **481** is moved in the up-down direction when the female threaded portion **482** is turned. When the male threaded portion **481** is moved upward, the spring **483** is extended. Therefore, the force with which the spring **483** pulls the rear end portion of the rotating plate **471** upward becomes stronger. When the rotating plate **471** is pulled upward, a force is applied to the feed mechanism **43** in a counterclockwise direction as seen from the right side, with the central shaft **470** serving as the center of rotation. Therefore, the force with which the front end portion of the belt **435** presses downward against the work cloth **100** becomes stronger. When the male threaded portion **481** is moved downward, the spring **483** contracts. Therefore, the force with which the spring **483** pulls the rear end portion of the rotating plate **471** upward becomes weaker. Accordingly, the force with which

the belt **435** presses against the work cloth **100** becomes weaker. In this manner, the force with which the belt **435** presses against the work cloth **100** can be adjusted by adjusting pressure adjustment mechanism **48**.

The mounting portion **42** and the presser foot **51** will be explained. As shown in FIG. **4**, the mounting portion **42** is provided above the feed mechanism **43** in the front end portion of the upper feed device **4**. The mounting portion **42** includes two holding portions **421** and **422**. The holding portions **421** and **422** are mounted on and fixed to the presser bar **27** by a shoulder screw **423**. The shoulder screw **423** includes a head **425**, a shank **426**, and a threaded portion **424**. The outside diameter of the shank **426** is slightly smaller than the outside diameter of the head **425**. The outside diameter of the threaded portion **424** is slightly smaller than the outside diameter of the shank **426**. The holding portions **421** and **422** are provided on the front end of the upper feed device **4**. The holding portion **421** is provided above the holding portion **422** and is set apart slightly from the holding portion **422**. Each of the holding portions **421** and **422** has a recessed portion that is recessed toward the left. The lower end portion of the presser bar **27** may be disposed in the recessed portions. A threaded hole (not shown in the drawings) is provided in the lower end portion of the presser bar **27**. The threaded hole extends through the presser bar **27** in the left-right direction. The threaded portion **424** may be screwed into the threaded hole. A slot (not shown in the drawings) is formed in the left side face of the head **425**. A tool (not shown in the drawings), which will be described below, may be fitted into the slot.

When mounting the upper feed device **4** to the presser bar **27**, the user may match the position of the threaded portion **424** to the position of the threaded hole in the presser bar **27**. In that state, the user may turn the head **425** with his or her fingers or fit the tool into the slot to turn the head **425**. The right side face of the shank **426** may thus come into contact with the left side faces of the holding portions **421** and **422**. In that state, if the shoulder screw **423** is turned and tightened, the holding portions **421** and **422** are clamped between the shank **426** and the presser bar **27**. In that state, the holding portions **421** and **422** are fixed to the presser bar **27**. The upper feed device **4** may thus be mounted to the presser bar **27**.

As shown in FIG. **4**, a presser foot support portion **511** is provided on the lower edge portion of the holding portion **422**. The presser foot support portion **511** straddles the front end portion of the feed mechanism **43** at the left and right. The presser foot support portion **511** extends obliquely downward and forward. The presser foot **51** is provided on the lower end of the presser foot support portion **511**. The sewing needle **29** may pass through a hole **513** in the presser foot **51**. The belt positioning portion **512** is provided at the rear of the hole **513**. The belt positioning portion **512** is a rectangular open portion that extends to the rear edge of the presser foot **51**. The front end portion of the belt **435** of the feed mechanism **43** may be disposed on the inner side of the belt positioning portion **512**. When the feed mechanism **43** is in the feed position, the part of the belt **435** that is below the pulley **433** may feed the work cloth **100** while pressing downward against the work cloth **100** within the belt positioning portion **512**.

The upper feed device **4** may be mounted to the presser bar **27** by the mounting portion **42**. Therefore, when the presser bar **27** is moved upward, the upper feed device **4** is also moved upward. The presser foot **51** is also moved away from the work cloth **100**. When the presser bar **27** is moved downward, the upper feed device **4** is also moved downward. The presser foot **51** may press downward against the work cloth **100**.

The drive mechanism **49** will be explained. As shown in FIGS. **7** and **8**, the drive mechanism **49** includes the motor **491**, gears **492** to **497**, and an electric substrate **498** (refer to FIG. **4**). The motor **491** is positioned above the base portion **451** and on the right side of the plate portion **473** (refer to FIGS. **4** and **8**). A drive shaft **499** of the motor **491** extends through the plate portion **473** and protrudes from the left side of the plate portion **473** (refer to FIG. **8**). The gear **492** is fixed to the projecting end of the drive shaft **499**. The gear **493** is positioned obliquely below and at the front of the gear **492**. The gear **492** meshes with the gear **493**. The gear **494** is provided on the left side face of the gear **493**. The diameter of the gear **494** is smaller than the diameter of the gear **493**. The gears **493** and **494** are formed as a single unit. The gear **495** is positioned in front of the gear **494**. The gear **494** meshes with the gear **495**. The gear **495** is provided around a central shaft **500**. The central shaft **500** extends through the plate portion **473** and protrudes from the right side of the plate portion **473** (refer to FIG. **8**). The gear **496** is provided around the central shaft **500** at the right of the plate portion **473**. The gear **496** meshes with the gear **497**, which is in front of the gear **496**. The gear **497** is formed as a single unit with the pulley **434** of the feed mechanism **43**. The electric substrate **498** (refer to FIG. **4**) is positioned at the left of the plate portion **473** and the gear **495**. The motor **491** is connected to the electric substrate **498** through a lead wire **501** (refer to FIGS. **4** and **5**).

The connecting portion **52** is connected to the electric substrate **498** via a connector **504** (refer to FIG. **9**). As shown in FIG. **3**, the connecting portion **52** extends from the electric substrate **498** to the outside of the housing **41** of the upper feed device **4** and may be connected to a connector **141** that is provided in the head **14** of the sewing machine **1**. The connector **141** is electrically connected to the control portion **60** (refer to FIG. **9**) of the sewing machine **1**. The motor **491** and the solenoid **53** are electrically connected to the control portion **60** of the sewing machine **1** via the electric substrate **498**, the connecting portion **52**, and the connector **141**.

When the motor **491** turns, the pulley **434** is rotated via the gears **492** to **497**. When the pulley **434** is rotated, the belt **435** is moved. The pulley **433** is rotated in conjunction with the moving of the belt **435**. The belt **435** can feed the work cloth **100** by moving while making contact with the work cloth **100**. Furthermore, in a case where the work cloth **100** is fed in the front-rear direction, the control portion **60** can perform control that synchronizes the timing of the operation by which the upper feed device **4** feeds the work cloth **100** and the timing of the operation by which the feed dog **34** feeds the work cloth **100**. Accordingly, the upper feed device **4** and the feed dog **34** can operate in coordination to feed the work cloth **100** in the front-rear direction.

The way in which the position of the feed mechanism **43** is switched between the feed position (refer to FIG. **5**) and the standby position (refer to FIG. **6**) will be explained. The upper feed device **4** can switch the position of the feed mechanism **43** between the feed position and the standby position by driving the solenoid **53** of the switching mechanism **45** in accordance with a command that is output by a CPU **61** based on the sewing data table, which is stored in an EEPROM **64**.

A case in which the position of the feed mechanism **43** is switched from the feed position to the standby position will be explained. In this case, the CPU **61** controls the solenoid **53** to move the drive shaft **531** obliquely downward and forward. The tip of the lever portion **460** is moved downward in conjunction with the movement of the drive shaft **531** (refer to the arrow **200** in FIG. **5**). Then the lever plate **452** is rotated counterclockwise, as seen from the right side, with the shaft member **459** as the center of rotation. That causes the extension portion **475** of the lever plate **452** and the shaft member **464** to rotate downward (refer to the arrow **201** in FIG. **5**).

Then the shaft member **467** is pushed toward the front via the linking member **465**, and the shaft member **467** slides toward the front along the hole **466** (refer to FIG. **4**) against the contracting force of the spring **468**.

When the shaft member **464** of the extension portion **475** is moved lower than the position of the spring **468** in the up-down direction, the shaft member **467** is pulled toward the rear by the contracting force of the spring **468** and by the movement of the linking member **465**. Therefore, the shaft member **467** slides toward the rear along the hole **466**. When the shaft member **467** is moved to the rear end of the hole **466**, the rotation of the lever plate **452** stops (refer to FIG. **6**).

In the process of the rotating of the lever plate **452**, the lower edge of the lever rear end portion **463** comes into contact with the shaft member **472** that is provided on the rotating plate **471** and pushes the shaft member **472** downward. The rear end of the rotating plate **471** on which the shaft member **472** is provided then is rotated downward, with the central shaft **470** of the rotating member **469** as the center of rotation (refer to the arrow **202** in FIG. **5**). Therefore, the feed mechanism **43** is rotated upward, with the central shaft **470** as the center of rotation (refer to the arrow **203** in FIG. **5**). The part of the belt **435** that is below the pulley **433** is thereby moved up away from the work cloth **100** (refer to FIG. **6**). In other words, the position of the feed mechanism **43** is switched from the feed position (refer to FIG. **5**) to the standby position (refer to FIG. **6**). The contracting force of the spring **468** operates constantly, so the shaft member **467** can be held in the state in which the shaft member **467** has moved to the rear end of the hole **466**. The shaft member **464** can therefore be held in the state in which the shaft member **464** has been moved lower than the spring **468**. Therefore, the position of the feed mechanism **43** can be held in the state in which the position of the feed mechanism **43** has been switched to the standby position.

In the process of the switching of the position of the feed mechanism **43** from the feed position (refer to FIG. **5**) to the standby position (refer to FIG. **6**), the left end of the shaft member **464** of the extension portion **475** turns the detector switch **457** on (refer to FIG. **9**). The CPU **61** of the sewing machine **1** can detect that the feed mechanism **43** is in the standby position.

Next, a case will be explained in which the position of the feed mechanism **43** is switched from the standby position (refer to FIG. **6**) to the feed position (refer to FIG. **5**). In this case, the CPU **61** controls the solenoid **53** to move the drive shaft **531** obliquely upward and rearward. The tip of the lever portion **460** is moved upward in conjunction with the movement of the drive shaft **531**. The lever portion **460** and the extension portion **475** operate in the opposite way from how the lever portion **460** and the extension portion **475** operate in the above case where the feed mechanism **43** is switched from the feed position to the standby position (refer to the arrows **204** and **205** in FIG. **6**).

When the lever portion **460** is rotated upward, the lever rear end portion **463** begins to move away from the shaft member **472**, which is provided on the rotating plate **471**. The rotating plate **471** is pulled upward by the spring **483** of the pressure adjustment mechanism **48**. The rotating plate **471** is therefore rotated upward, with the central shaft **470** as the center of rotation (refer to the arrow **206** in FIG. **6**). Therefore, the feed mechanism **43** is rotated downward (refer to the arrow **207** in FIG. **6**). The part of the belt **435** that is below the pulley **433** may thereby come into contact with the work cloth **100** and may press downward against the work cloth **100**. In other words, the position of the feed mechanism **43** is switched to the feed position. In this state, the upper feed device **4** may operate in coordination with the feed dog **34** to feed the work cloth **100**.

The contracting force of the spring **468** operates constantly, so the shaft member **467** can be held in the state in which the shaft member **467** has moved to the rear end of the hole **466**. The shaft member **464** can therefore be held in the state in which the shaft member **464** has been moved higher than the spring **468**. Therefore, the position of the feed mechanism **43** can be held in the state in which the position of the feed mechanism **43** has been switched to the feed position. In the process of the switching of the position of the feed mechanism **43** from the standby position (refer to FIG. **6**) to the feed position (refer to FIG. **5**), the left end of the shaft member **464** of the extension portion **475** is moved away from the detector switch **457** (refer to FIG. **9**), turning the detector switch **457** off. The CPU **61** of the sewing machine **1** can detect that the feed mechanism **43** is in the feed position.

The electrical configuration of the sewing machine **1** will be explained with reference to FIG. **9**. As shown in FIG. **9**, the control portion **60** of the sewing machine **1** includes the CPU **61**, a ROM **62**, a RAM **63**, the EEPROM **64**, and an input/output interface **65**, all of which are connected to one another via a bus **67**. ROM **62** stores programs for the CPU **61** to perform processing, as well as data and the like. EEPROM **64** includes the sewing data table storage area **641**. A plurality of sewing data tables including sewing data table **90** (refer to FIG. **10**), which will be described below, are stored in the sewing data table storage area **641**. EEPROM **64** also stores various types of other data. RAM **63** may store various types of temporary data.

The switch cluster **21**, the touch panel **26**, drive circuits **71**, **72**, **74**, **75**, and the connector **141** are electrically connected to the input/output interface **65**. The drive circuit **71** may drive the feed adjustment motor **78**. The drive circuit **72** may drive the sewing machine motor **79**. The drive circuit **74** may drive the needle bar swinging motor **80**. The drive circuit **75** may drive the liquid crystal display **15**.

The connector **141** may be connected to one end of the connecting portion **52**. The connecting portion **52** is connected to the connector **504**. The connector **504** is electrically connected to the detector switch **457** and drive circuits **151** and **152**. The connector **504** and the drive circuits **151** and **152** and are mounted on the electric substrate **498**. The drive circuit **151** may drive the motor **491**. The drive circuit **152** may drive the solenoid **53**. By controlling the drive circuit **151**, the CPU **61** can control the driving of the motor **491**. By controlling the drive circuit **152**, the CPU **61** can drive the solenoid **53**. The CPU **61** also can detect the output (the on/off state) of the detector switch **457**.

Although this is not shown in the drawings, the circuitry is configured such that a Low signal is input to the CPU **61** in a case where the upper feed device **4** is connected via the connector **141**. Furthermore, the circuitry is configured such that a High signal is input to the CPU **61** in a case where the upper feed device **4** is not connected via the connector **141**. By detecting one of the Low signal and the High signal, the CPU **61** can detect whether the upper feed device **4** and the sewing machine are electrically connected.

The sewing data table **90** will be explained with reference to FIG. **10**. The sewing data table **90** is a data table for sewing a sewing pattern **91** that is shown in FIG. **11**. In the sewing data table **90**, a stitch number N, swing data, front-rear feed data, and transverse feed data are associated with one another. The stitch number N indicates the order in which the sewing is to be performed. Needle drop points X**1** to X**15** in the swing

pattern **91** (refer to FIG. **11**) indicate the needle drop points for the stitch numbers N 1 to 15, respectively.

The needle bar of the sewing machine **1**, to the lower end of which the sewing needle **29** may be attached, is configured such that the needle bar can be moved (swung) to the left and to the right by the needle bar swinging mechanism. The swing data indicate the amount of movement, in the left-right direction, of the needle drop point of the sewing needle **29** that is attached to the lower end of the needle bar. Among the values for the swing data, a positive value indicates an amount of movement of the needle bar to the right, and a negative value indicates an amount of movement of the needle bar to the left. In the present embodiment, the amount of movement of the needle bar of the sewing machine **1** in the left-right direction is a maximum of 9 millimeters of movement of the needle drop point, and the leftmost position of a needle drop point in the range of movement in the left-right direction is defined as an origin point 0. The needle drop point is the point where the tip (the lower end) of the sewing needle **29** pierces the work cloth **100**.

The front-rear feed data indicate the feed amount of the work cloth **100** in the front-rear direction. Among the values for the front-rear feed data, a positive value indicates the feed amount of the work cloth **100** toward the rear, and a negative value indicates the feed amount of the work cloth **100** toward the front. The feed dog **34**, operating one of alone and in coordination with the upper feed device **4**, may feed the work cloth **100** toward one of the front and the rear by the feed amount that is indicated by the front-rear feed data. The transverse feed data indicate the feed amount of the work cloth **100** in the left-right direction. Among the values for the transverse feed data, a positive value indicates the feed amount of the work cloth **100** toward the left, and a negative value indicates the feed amount of the work cloth **100** toward the right. The feed dog **34** may feed the work cloth **100** toward one of the left and the right by the feed amount that is indicated by the transverse feed data. In the present embodiment, the feed dog **34** can feed the work cloth **100** by 0.5 millimeters to one of the left and the right (transversely) for any one stitch.

Main processing will be explained with reference to the flowchart in FIG. **12**. The main processing is performed by the CPU **61** of the sewing machine **1** in accordance with a program that is stored in the ROM **62**. The main processing is performed in a case where, for example, a desired pattern has been selected by a panel operation and the sewing start/stop switch has been pressed. In the explanation that follows, the selected pattern is assumed to be the sewing pattern **91** (refer to FIG. **11**), and the sewing data for sewing the sewing pattern **91** are assumed to be the data in the sewing data table **90** (refer to FIG. **10**).

As shown in FIG. **12**, a determination is made as to whether the upper feed device **4** and the sewing machine **1** (the control portion **60**) are electrically connected via the connecting portion **52** of the upper feed device **4** (Step S**11**). The method of detecting whether the upper feed device **4** and the sewing machine **1** are connected at Step S**11** is described above. If the upper feed device **4** and the sewing machine **1** are electrically connected (YES at Step S**11**), the stitch number N is set to 1 (Step S**12**). The stitch number N is stored in the RAM **63**. Next, the sewing data table **90** is referenced, and a determination is made as to whether the value of the transverse feed data that correspond to the stitch number N is zero (millimeters) (Step S**13**). In other words, a determination is made as to whether the work cloth **100** is to be fed in the front-rear direction, which is the direction in which the feed mechanism **43** can feeds the work cloth **100**.

If the value of the transverse feed data that correspond to the stitch number N is zero (millimeters), that is, if the work cloth **100** is to be fed in the front-rear direction (YES at Step S**13**), the on/off state of the detector switch **457** (refer to FIG. **9**) is detected. A determination is thus made as to whether the position of the feed mechanism **43** is in the feed position (refer to FIG. **5**) (Step S**14**). If the detector switch **457** is off, a determination is made that the feed mechanism **43** is in the feed position (YES at Step S**14**). In this case, the sewing is performed for the stitch that corresponds to the stitch number N in the sewing data table **90** (Step S**18**). The processing at Step S**18** will be described in detail below, using an example.

If the detector switch **457** is on at Step S**14**, the feed mechanism **43** is in the standby position (refer to FIG. **6**). Therefore, a determination is made that the feed mechanism **43** is not in the feed position (NO at Step S**14**). Next, the solenoid **53** of the switching mechanism **45** is controlled such that the drive shaft **531** is moved obliquely upward and rearward. In this manner, the position of the feed mechanism **43** is switched from the standby position (refer to FIG. **6**) to the feed position (refer to FIG. **5**) (Step S**15**). Next, the sewing of the one stitch is performed (Step S**18**).

After the sewing of the one stitch is performed (Step S**18**), the CPU **61** determines whether the sewing is to be terminated (Step S**19**). For example, if the CPU **61** detects that the sewing start/stop switch has been pressed, the CPU **61** determines that the sewing is to be terminated (YES at Step S**19**). In a case where a text character pattern has been selected for which the stitch numbers N are determined in advance, for example, the CPU **61** determines that the sewing is to be terminated (YES at Step S**19**) after the sewing of the last stitch in the sewing data table has been performed (Step S**18**). If the sewing is not to be terminated (NO at Step S**19**), the CPU **61** increments the stitch number N (Step S**20**). Next, the processing returns to Step S**13**.

At Step S**13**, if the value of the transverse feed data that correspond to the stitch number N is not zero (millimeters) (NO at Step S**13**), the work cloth **100** is to be fed in the left-right direction, which is the direction in which the feed mechanism **43** cannot feed the work cloth **100**. In this case, the on/off state of the detector switch **457** is detected. A determination is thus made as to whether the feed mechanism **43** is in the standby position (refer to FIG. **6**) (Step S**16**). If the detector switch **457** is on, a determination is made that the feed mechanism **43** is in the standby position (YES at Step S**16**), and the sewing of the one stitch is performed at Step S**18**, which will be described below.

If the detector switch **457** is off, the feed mechanism **43** is in the feed position (refer to FIG. **5**). Therefore, a determination is made that the feed mechanism **43** is not in the standby position (refer to FIG. **6**) (NO at Step S**16**). Next, the solenoid **53** of the switching mechanism **45** is controlled such that the drive shaft **531** is moved obliquely downward and forward. In this manner, the position of the feed mechanism **43** is switched from the feed position (refer to FIG. **5**) to the standby position (refer to FIG. **6**) (Step S**17**). Next, the sewing of the one stitch is performed (Step S**18**).

The processing at Step S**18** will be described in detail. At Step S**18**, first, the work cloth **100** is fed by the feed amounts that are indicated by the front-rear feed data and the transverse feed data in the sewing data table **90**. At this time, if the value of the transverse feed data is zero (millimeters) (YES at Step S**13**), the feed mechanism **43** is disposed in the feed position (refer to FIG. **5**) (Step S**15** or YES at Step S**14**). Therefore, the work cloth **100** is fed in the front-rear direction by the coordinated operation of the feed dog **34** and the feed mechanism **43**, by the feed amount that is indicated by the

front-rear feed data. If the value of the transverse feed data is not zero (millimeters) (NO at Step S13), the feed mechanism **43** is disposed in the standby position (refer to FIG. **6**) (Step S17 or YES at Step S16). Therefore, the work cloth **100** is fed in the front-rear direction and the left-right direction by the feed dog **34** alone, by the feed amounts that are indicated by the front-rear feed data and the transverse feed data. Next, the needle bar is moved in the left-right direction by the amount of movement that is indicated by the swing data, the needle bar is driven up and down, and the sewing of the one stitch is performed.

A case will be explained in which the execution of the main processing is started when the feed mechanism **43** of the upper feed device **4** is in the standby position (refer to FIG. **6**), and the sewing is performed based on the sewing data table **90** (refer to FIG. **10**). In a case where the stitch number N is 1, the values of the swing data, the front-rear feed data, and the transverse feed data are all zero (millimeters) (refer to FIG. **10**). Therefore, the determination is made that the value of the transverse feed data is zero (millimeters) (YES at Step S13). Then the position of the feed mechanism **43** is switched to the feed position (refer to FIG. **5**) (NO at Step S14; Step S15). At Step S18, the needle bar is moved up and down and the sewing is performed (refer to the needle drop point X1 in FIG. **11**) without the work cloth **100** being fed and without the needle bar being moved in the left-right direction. In a case where the values of the swing data, the front-rear feed data, and the transverse feed data are all zero (millimeters), the work cloth **100** is not fed. Therefore, the processing may be set such that the switching of the position of the feed mechanism **43** is not performed.

If the sewing is continued (NO at Step S19), the stitch number N is incremented such that the stitch number N is set to 2 (Step S20). Next, because the value of the transverse feed data for the stitch number N "2" is 0.5 (millimeters) (refer to FIG. **10**), the determination is made that the value of the transverse feed data is not zero (millimeters) (NO at Step S13). Here, the feed mechanism **43** is in the feed position. Therefore, the determination is made that the position of the feed mechanism **43** is not the standby position (NO at Step S16), and the position of the feed mechanism **43** is switched from the feed position (refer to FIG. **5**) to the standby position (refer to FIG. **6**) (Step S17).

Next, the value of the front-rear feed data is zero (millimeters), and the value of the transverse feed data is 0.5 (millimeters). Therefore, the feed dog **34** is controlled such that the work cloth **100** is fed 0.5 millimeters to the left. In other words, the needle drop point is moved 0.5 millimeters to the right. The feed mechanism **43** cannot feed the work cloth **100** in the left-right direction. The feed mechanism **43** is separated from the work cloth **100**. Therefore, the feed mechanism **43** does not impede the feeding of the work cloth **100** to the left. Accordingly, the work cloth **100** is properly fed to the left. Next, because the value of the swing data is 1.5 (millimeters) (refer to FIG. **10**), the needle bar (the sewing needle **29**) is moved 1.5 millimeters to the right. In other words, the needle drop point is moved to the right by a total of 2 millimeters. Then the needle bar is moved up and down, and the sewing of the one stitch is performed (Step S18; refer to the needle drop point X2 in FIG. **11**). A stitch is thus formed with a length of 2 millimeters in the left-right direction.

If the sewing is continued (NO at Step S19), the stitch number N is set to 3 (Step S20). In the case where the stitch number N is 3, the determination is made that the value of the transverse feed data is not zero (millimeters) (NO at Step S13). Then the determination is made that the feed mechanism **43** is in the standby position (YES at Step S16). The feed dog **34** is controlled such that the work cloth **100** is moved 0.5 millimeters to the left, the needle bar is moved an additional 1.5 millimeters to the right, and the sewing is performed (Step S18; refer to the needle drop point X3 in FIG. **11**).

If the sewing is continued (NO at Step S19), the stitch number N is set to 4 (Step S20). In the sewing data table **90**, the value of the transverse feed data that correspond to the stitch number N "4" is zero (millimeters), so the determination is made that the value of the transverse feed data is zero (millimeters) (YES at Step S13). In this case, the feed mechanism **43** is in the standby position. Therefore, the determination is made that the feed mechanism **43** is not in the feed position (NO at Step S14), and the position of the feed mechanism **43** is switched from the standby position (refer to FIG. **6**) to the feed position (refer to FIG. **5**) (Step S15). Next, the value of the front-rear feed data is 2 (millimeters). Therefore, the feed dog **34** and the feed mechanism **43** are controlled such that the work cloth **100** is moved 2 millimeters toward the rear. In other words, the needle drop point is fed 2 millimeters toward the front. At this time, the feed mechanism **43** presses and feeds the work cloth **100**. Therefore, the work cloth **100** can be fed more reliably than in a case where only the feed dog **34** feeds the work cloth **100**.

Next, because the value of the swing data is 1.0 (millimeters), the needle bar (the sewing needle **29**) is moved additional 1.0 millimeters to the right. Then the needle bar is moved up and down, and the sewing of the one stitch is performed (Step S18; refer to the needle drop point X4 in FIG. **11**). A stitch is thus formed that extends 2 millimeters toward the front and 1 millimeter toward the right.

If the sewing is continued (NO at Step S19), the stitch number N is set to 5. In the case where the stitch number N is 5, the determination is made that the value of the transverse feed data is zero (millimeters) (YES at Step S13). Then the determination is made that the feed mechanism **43** is in the feed position (YES at Step S14). The feed dog **34** and the feed mechanism **43** are controlled such that the work cloth **100** is moved 2 millimeters toward the rear. The needle bar is moved an additional 1 millimeter to the right, and the sewing is performed (refer to the needle drop point X5 in FIG. **11**). The stitch number N is incremented, and the same sort of sewing is repeated. The sewing pattern **91** shown in FIG. **11** is thus formed. When the sewing start/stop switch is pressed, for example, the CPU **61** determines that the sewing is to be terminated (YES at Step S19) and terminates the main processing.

In the processing at Step S11, if the upper feed device **4** is not mounted on the sewing machine **1** (NO at Step S11), the sewing of one stitch is performed (Step S21), based on the sewing data table **90**, in the same manner as at Step S18. At Step S21, the upper feed device **4** has not been mounted, so the feeding of the work cloth **100** is performed by the feed dog **34** alone. Next, the CPU **61** determines whether the sewing is to be terminated (Step S22), in the same manner as at Step S19. If the sewing is not to be terminated (NO at Step S22), the CPU **61** increments the stitch number N (Step S23), in the same manner as at Step S20. The processing returns to Step S21, and the sewing is continued. If the sewing is to be terminated (YES at Step S22), the CPU **61** terminates the main processing.

In the present embodiment, the CPU **61** of the sewing machine **1** drives the feed mechanism **43** in the feed position in a case where the feed dog **34** feeds the work cloth **100** in the front-rear direction, based on the sewing data table **90** that is stored in the EEPROM **64** (YES at Step S13; Step S14; Step S15; Step S18). In a case where the feed dog **34** feeds the work cloth **100** in the left-right direction, the CPU **61** operates the

solenoid **53** of the switching mechanism **45** such that the position of the feed mechanism **43** is automatically switched from the feed position to the standby position, then performs the sewing (NO at Step S**13**; Steps S**16** to S**18**). Therefore, when the feed dog **34** feeds the work cloth **100** in a direction (the left-right direction in the present embodiment) that is different from the front-rear direction in which the feed mechanism **43** can feed the work cloth **100**, the feed mechanism **43** does not impede the feeding of the work cloth **100**. The work cloth **100** can therefore be fed properly in the left-right direction.

The upper feed device **4** in the present embodiment can automatically switch the position of the feed mechanism **43** between the feed position and the standby position. The work cloth **100** can therefore be fed properly in the front-rear direction and in the left-right direction. Therefore, it is possible to sew a pattern (for example, the sewing pattern **91** shown in FIG. **11**) that is to be formed as the work cloth **100** is fed in the front-rear direction and in the left-right direction.

In the present embodiment, the work cloth **100** can be moved in the front-rear direction by being clamped between the upper feed device **4** and the feed dog **34**. The work cloth **100** may be a work cloth that is difficult to sew (difficult to feed), such as a vinyl cloth, a synthetic leather, or the like, for example, or the work cloth **100** may be a material on which sewing slippage tends to occur, such as a quilted material in which cotton is sandwiched between two layers of cloth, a velvet with a raised nap surface, or the like. In the present embodiment, the work cloth **100** can be fed reliably in the front-rear direction even in these sorts of cases. The quality of the sewing may thereby be improved. As shown in FIG. **5** and the like, there is a case in which ordinary sewing may be performed on two of the work cloths **100**, one on top of the other. Even in this sort of case, the upper and lower work cloths **100** can be fed reliably without any slippage. The quality of the sewing may therefore be improved even more. Additionally, in a case where the work cloth **100** is to be fed in the left-right direction, the feed mechanism **43** automatically moves away from the work cloth **100**, as described above. Therefore, the work cloth **100** can be fed properly in the left-right direction. The sewing can therefore be performed more efficiently than in a case where the user switches the position of the feed mechanism **43** by a manual operation.

The present disclosure is not limited to the embodiment that is described above, and various types of modifications can be made. For example, in the embodiment that is described above, the position of the feed mechanism **43** is detected by the detecting of the on/off state of the detector switch **457** at Steps S**14** and S**16**. However, the position of the feed mechanism **43** may be detected by a different method. For example, the CPU **61** may store information that indicates that the CPU **61** has controlled the switching mechanism **45** to perform an operation that switches the position of the feed mechanism **43**. Then the CPU **61** may detect the current position of the feed mechanism **43** by referencing the stored information about the previously performed operation.

In the embodiment that is described above, the sewing data table **90** is stored in the EEPROM **64**, but the present disclosure is not limited to this example. For example, the sewing data table **90** may be stored in an external storage device, such as a memory card that can be mounted in the sewing machine **1**.

In the embodiment that is described above, the upper feed device **4** can be mounted on and removed from the sewing machine **1**. The upper feed device **4** may be affixed to the sewing machine **1** such that the upper feed device **4** cannot be removed. The upper feed device **4**, as well as the various types of mechanisms that are included in the upper feed device **4**, may be included in the sewing machine **1**.

In the embodiment that is described above, the switching of the position of the feed mechanism **43** (to the feed position and the standby position) is performed by the controlling of the solenoid **53**. However, the position of the feed mechanism **43** may be switched by a different method. For example, a motor may be added to the upper feed device **4**. The position of the feed mechanism **43** may then be switched by using the driving force of the added motor to operate the lever portion **460**. The upper feed device **4** may be configured such that the lever portion **460** can be operated by the solenoid **53** or the like and also the lever portion **460** can be operated manually. The position of the feed mechanism **43** may thus be switched manually.

In the embodiment that is described above, the direction in which the feed mechanism **43** of the upper feed device **4** can feed the work cloth **100** is the front-rear direction, but the present disclosure is not limited to this example. For example, the feed mechanism **43** may be configured to feed the work cloth **100** in the left-right direction. In that case, when the work cloth **100** is to be fed in the left-right direction, the feed mechanism **43** may be disposed in the feed position, and the work cloth **100** may be fed by the coordinated operation of the feed mechanism **43** and the feed dog **34**. Then, in a case where the feed dog **34** is to feed the work cloth **100** in the front-rear direction, the position of the feed mechanism **43** may be switched to the standby position. In that case, the work cloth **100** may be fed in the front-rear direction by the feed dog **34** alone.

The apparatus and methods described above with reference to the various embodiments are merely examples. It goes without saying that they are not confined to the depicted embodiments. While various features have been described in conjunction with the examples outlined above, various alternatives, modifications, variations, and/or improvements of those features and/or examples may be possible. Accordingly, the examples, as set forth above, are intended to be illustrative. Various changes may be made without departing from the broad spirit and scope of the underlying principles.

What is claimed is:

1. A sewing machine comprising:

a first drive portion that is disposed above a bed of the sewing machine and that is configured to drive to feed, in a first direction, a work cloth placed on the bed;

a switching portion that is configured to switch a position of the first drive portion between a first position and a second position, wherein the first drive portion is configured to feed the work cloth at the first position, the first drive portion is configured to be separated from the work cloth at the second position, and the second position is a position that is higher and farther away from the bed than the first position;

a second drive portion that is provided inside the bed and that is configured to drive to feed the work cloth in the first direction and in a second direction that is different from the first direction;

a control portion; and

a memory that is configured to store computer-readable instructions that instruct the sewing machine to execute steps of:

driving the first drive portion in the first position, in a case where the second drive portion drives to feed the work cloth in the first direction, based on sewing data,

switching the position of the first drive portion from the first position to the second position by operating the switching portion, in a case where the second drive

portion drives to feed the work cloth in the second direction, based on the sewing data, and

switching the position of the first drive portion from the second position to the first position by operating the switching portion, if the first drive portion is in the second position, in a case where the second drive portion drives to feed the work cloth in the first direction, based on the sewing data.

2. The sewing machine according to claim **1**, wherein the switching portion includes an actuator that is configured to switch the position of the first drive portion, and the switching of the position of the first drive portion from the first position to the second position is performed by controlling the actuator.

3. The sewing machine according to claim **1**, wherein

the switching portion includes an actuator that is configured to switch the position of the first drive portion, and

the switching of the position of the first drive portion from the second position to the first position is performed by controlling the actuator.

4. The sewing machine according to claim **1**, wherein the first drive portion includes:

a motor;

a first pulley that is configured to be rotated in conjunction with a rotation of the motor;

a second pulley that is separated from the first pulley, that is disposed above the bed, and that is configured to be rotated in conjunction with a rotation of the first pulley; and

a belt that is provided around the first pulley and the second pulley and that is configured to be moved in conjunction with the rotation of the first pulley rotated by the motor, and a contact portion is configured to be in contact with the work cloth when the first drive portion is in the first position and to be separated from the work cloth when the first drive portion is in the second position, the contact portion being a part of the belt that is below the second pulley.

5. An upper feed device comprising:

a first drive portion that is disposed above a bed of a sewing machine and that is configured to drive to feed, in a first direction, a work cloth placed on the bed;

a switching portion that is configured to switch a position of the first drive portion between a first position and a second position, wherein

the first drive portion is configured to feed the work cloth at the first position, and configured to be separated from the work cloth at the second position,

the second position is a position that is different from the first position, and

in response to instructions that are output by a control portion of the sewing machine based on sewing data:

the first drive portion drives in the first position in a case where a second drive portion drives to feed the work cloth in the first direction,

the switching portion switches the position of the first drive portion from the first position to the second position in a case where the second drive portion drives to feed the work cloth in a second direction that is different from the first direction, the second drive portion being provided inside the bed, and

the switching portion switches the position of the first drive portion from the second position to the first position, if the first drive portion is in the second position, in a case where the second drive portion drives to feed the work cloth in the first direction, in response to instructions that is output by the control portion based on the sewing data.

6. The upper feed device according to claim **5**, wherein the switching portion includes an actuator that is configured to switch the position of the first drive portion, and the actuator switches the position of the first drive portion from the first position to the second position in response to instructions that is output by the control portion.

7. The upper feed device according to claim **5**, wherein the switching portion includes an actuator that is configured to switch the position of the first drive portion, and the actuator switches the position of the first drive portion from the second position to the first position in response to instructions that is output by the control portion.

8. The upper feed device according to claim **5**, wherein the first drive portion includes:

a motor;

a first pulley that is configured to be rotated in conjunction with a rotation of the motor;

a second pulley that is separated from the first pulley, that is disposed above the bed, and that is configured to be rotated in conjunction with a rotation of the first pulley; and

a belt that is provided around the first pulley and the second pulley and that is configured to be moved in conjunction with the rotation of the first pulley rotated by the motor, and a contact portion is configured to be in contact with the work cloth when the first drive portion is in the first position and to be separated from the work cloth when the first drive portion is in the second position, the contact portion being a part of the belt that is below the second pulley.

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